

THE INFLUENCE OF THE LEVEL OF WINTER NUTRITION
ON THE PERFORMANCE OF HEIFER CALVES

by

VIRGIL D. SEVERNS

B. S., Kansas State College
of Agriculture and Applied Science, 1951

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1956



2668
T4
1956
S49
Spec. Coll.

TABLE OF CONTENTS

INTRODUCTION.....1

REVIEW OF LITERATURE.....2

EXPERIMENTAL MATERIALS, METHODS AND PROCEDURE.....17

 Experiment I.....18

 Experiment II.....20

 Experiment III.....21

EXPERIMENTAL RESULTS AND DISCUSSION.....25

 Experiment I.....25

 Experiment II.....26

 Experiment III.....28

SUMMARY.....32

ACKNOWLEDGMENTS.....34

LITERATURE CITED.....35

INTRODUCTION

The method of handling beef heifers is of primary concern to a great many of the beef cattle producers and feeders in this and other areas. In the past, especially when marketed at an older age, there has been discrimination against heifers on the markets. During periods of heavy culling the number of young heifers reaching the market may almost equal that of steers.

Some stockmen who are equipped to keep them separated from bulls, prefer heifers to steers. Two major reasons for this are that heifers finish faster and usually can be bought as feeders or stockers from two to four cents per pound cheaper than steer calves. After being fattened, heifers that are known to be unbred will sometimes sell for as much as steers.

With this in mind work was begun to establish a definite system of purchasing, handling, feeding, finishing and marketing heifers which would best utilize the feeds and the labor available on the farm as well as meet the demands of the market.

The system as developed started with the purchase of 350 to 450 pound heifer calves in the fall of the year when they were plentiful in number and sold at a seasonal-low price. This makes it possible to utilize a maximum of roughage and a minimum of grain or other more costly feeds in producing "good" to "choice" grade market slaughter cattle at about 18 months of age and weighing from 700 to 900 pounds. The size and grade of carcass produced is in demand by consumers and therefore brings a good price. Well finished light weight cattle usually are scarce during the fall season.

The use of large amounts of roughage during the wintering phase is of great economic importance. Therefore the method used to winter heifer calves is of prime importance in determining and obtaining maximum feed efficiency and growth.

The objective of this study was to determine the effect of wintering on total gains, carcass grades, dressing percentage, shrinkage in shipping to market and margin of profit.

The experiments varied from a good level of wintering to a low level of wintering and were followed, first by a grazing phase, then with a full feeding period of about 100 days.

REVIEW OF LITERATURE

Young animals required less feed per 100 pounds of gain than older ones, according to Morrison (1936). The gains of younger animals were more watery and contained more protein and less fat. Fat has a higher energy value, therefore, more net energy is required to put a pound of gain on a mature fattening animal than on a young growing one. Young animals consume more feed in proportion to body weight and therefore have more left after body maintenance for increase in weight than older animals.

Clawson (1926) stated that young animals made larger gains than older ones, when figured as a percentage of initial weight. This was believed to be true because of the greater consumption of feed in proportion to their weight and the type of tissue developed. The gains on a per-steer basis were about the same

number of pounds. Therefore, two 500 pound calves would make considerably more gain than one 1000 pound animal.

Clawson (1926) also found that rate of gain was most rapid in the early part of the grazing season and decreased gradually in the fall.

Stephens, et al. (1949) found that steers wintered on a high plane of nutrition lost weight during the first four weeks on pasture, whereas those on a lower plane of wintering gained more than two pounds per head per day.

An animal resembles a machine in that it has been shown to be most efficient when operating at full capacity. Even under ideal conditions much of the total feed eaten is used for body maintenance. Guilbert and Hart (1946) illustrated this efficiency by using three levels of nutrition.

Calves fed for maximum gain weighed 900 pounds in less than 14 months and graded "choice" as slaughter cattle. Calves fed a limited amount of supplemental feed reached 900 pounds in fleshy feeder condition at 21 months of age. When no supplemental feeding was done the calves reached 900 pounds at 31 months of age. Much more total feed was required by these steers to attain the same weight that the other calves reached in 14 or 21 months. There was added risk, interest, other costs and a resulting product of lower value.

Guilbert and Hart (1946) found that on dry range forage one to one and one-half pounds daily of cottonseed cake or its equiv-

alent will meet protein requirements and continue to produce gains until rains leach the forage.

Winchester and Howe (1955) made a study with six pairs of monozygotic (identical) twin steers on the relative effects of liberal and restricted feed intake. At the end of the restricted feeding period the retarded animals were also fed a liberal ration. They reached 1000 pound slaughter weight on approximately the same total intake of energy as steers fed liberally throughout the experiment. This was explained by the fact that after the reduced feeding ended, the retarded steers made more economical gains than their co-twins.

This was somewhat in contrast to the findings of Guilbert and Hart (1946) mentioned above, but in partial agreement with Morrison's (1936) statement that farm animals digest their food more completely when fed a maintenance ration than when fed a liberal amount of the same feeds. However, when fed a considerable amount of roughage, ruminants may digest a full feed as completely as a scanty feed.

It was concluded by Winchester and Howe (1955) that under conditions of feed scarcity beef cattle between the ages of six and twelve months can be carried at an energy level as low as maintenance, if nutritional needs other than energy are supplied. No later loss occurred in efficiency of feed utilization, meat quality, or in proportion of lean meat as compared with fat and bone.

Again emphasizing the ability of livestock to live on energy rations at maintenance or lower levels when other essential nutrients were present in sufficient quantity, was the work of Franklin, et al. (1955). They found that Merino weaners maintained for 243 days on extremely low drought rations (3.33 pounds starch equivalent per week) had a death loss of only 16.7 percent when supplemented with ground limestone and vitamin A. This compared with a death loss of 63 percent when no vitamin A was given.

Morrison (1936) stated that cattle fed a ration supplying necessary body nutrients and only enough energy to maintain body weight, continued to grow in height for 70 to 120 days at the same rate as steers fed liberally. Growth became less rapid and ceased at from six months to a year and a half. Unless underfeeding was continued for a long time, animals were not permanently stunted. Following such subnormal feeding with liberal feeding will result in rapid gains and generally less feed per 100 pounds gain. To stockmen this means that under certain conditions it may be profitable to carry growing animals through the winter on roughage and protein supplement only, and even with a slight weight loss they will make rapid and economical gains on pasture, if they are in thrifty condition.

Lush, et al. (1930) found that weights of growing range cattle increased very rapidly from mid-April to mid-July and

continued in some years until early December. Rate of increase usually slowed down from late summer to early winter. From mid-October to mid-January weights usually increased only a little and an actual loss occurred from mid-January to early March, which was barely regained by mid-April. Variations from typical growth patterns were directly connected with weather fluctuations. Some skeletal growth was independent of the season for its continuation whereas other skeletal growth continued, but was slowed down during the low plane of nutrition of the winter months.

Sheets and Tuckwiller (1926) found that between the end of the plant growing season and the start of the winter feeding phase there was a loss in weight. It took about all of the winter gain to compensate for this loss, so that the steers going on grass in the spring weighed about the same as they had at the end of the growing season the previous fall, six months previously.

Greater winter gains made due to differences in winter rations are gradually minimized during the summer grazing phase. Therefore if cattle are to be marketed early from grass it is more important that they make a larger winter gain than if they are to be marketed late. Due to the small difference in total winter and pasture gains made by the end of the grazing season, the cost of the winter ration should be the determining factor in choosing the winter ration when cattle are to be finished on grass.

The work of Connell, et al. (1948) confirms the above statement. They wintered steer calves on dry sorghum roughage and cane silage rations. Cottonseed meal or soybean meal added to these rations stimulated appetite and greatly increased gains at a feed cost of only six to eight cents per pound of extra gain. At the end of a six month grazing period the difference in weight gains was greatly reduced and the cost per pound of the extra gain was about 18 cents. By the end of the fattening phase it was still further reduced and amounted to 22.3 cents per pound of extra gain. According to Morrison's energy tables and expressed in terms of feed replacement, the value of the protein supplement fed during the winter was increased seven times based on the winter gain only. This replacement value was lost by the end of summer. From a practical standpoint, it would have paid to feed protein supplement if calves were sold at the end of the wintering period, but its value was questionable if calves were carried through grazing and fattening phases.

Kincaid, et al. (1945) found that each pound of winter gain reduced summer gain by .58 of a pound and increased annual gain .42 of a pound.

Guilbert, et al. (1944) used a three phase feeding system which demonstrated the benefit of early post weaning gain. During the first of three phases weanling calves on dry grass supplemented with cottonseed cake and rolled barley gained a

pound to a pound and a quarter daily for a total gain of 195 pounds; unsupplemented calves lost about 20 pounds per head. During the second phase the previously unsupplemented lot was fed supplemental feed while on good grass and the first group was maintained on grass only. They gained 300 and 180 pounds respectively. At the end of the third or finishing period steers fed concentrates during the first phase weighed 95 pounds more than those supplemented in the second phase. For the lighter steers to have reached this weight an additional 40 or 50 days and approximately 400 to 450 pounds each of concentrates and harvested roughage would have been required.

It was concluded that 200 to 300 pounds of supplemental feed given to weanling calves on dry grass would result in about 100 pounds of additional weight. Feed lot finishing time was reduced to about half. Not only was a significantly greater profit made (\$17.51 per head for an additional feed cost of only \$1.40 or 70 pounds of concentrates) but also a maximum amount of human food was produced from feed available.

According to Snapp (1952) the winter ration should prepare cattle for making maximum use of the summer ration. Cattle to be fed on pasture should be wintered better than if just grazed; if they were grazed till mid-summer and then full fed they should be wintered on a higher plane than if they were grazed all summer.

"The amount of gain made in summer varies inversely with the amount of gain made during the winter."

Kincaid (1939) observed that there was a significant negative correlation between winter gain or loss and summer gain on grass with yearling steers. About one-third of the variance of summer gains was due to winter weight changes. Total gains were higher for those having the highest winter gain.

These statements by Snapp and Kincaid were in general agreement with the findings of several other workers. Steers making larger winter gains, made larger total gains for the year; steers making only slight gains or losing weight in winter made the greatest summer pasture gains; differences in weight at the end of winter due to rations are gradually minimized during summer grazing but never fully overcome according to the findings of Sheets and Tuckwiller (1924) and was in agreement with work done by Stephens, et al. (1949), Nelson and Campbell (1954), Darlow, et al. (1948), Dyer (1952), Sheets and Tuckwiller (1926), Sheets (1924), and Black (1927).

With one exception Dyer and Guyer (1950) found the rate of gain on pasture was in reverse order to that from the wintering period. After the completion of wintering and grazing phases, cattle fed to grade "good" made from 60 to 65 percent of their total gain from roughage and pasture combined, 33 to 42 percent of which was made from pasture. All lots, whether wintered on a high or low plane of nutrition, required about equal amounts of

grain to fatten to the same grade after the grazing phase. Thus the winter ration of roughage only was the simplest and proved to be the most satisfactory.

Johnson, et al. (1952) found the rate of gain and feed requirements of steers being finished were not affected by the level of winter feeding following a 120 to 150 day grazing period. The total winter and pasture gains of steers wintered on a low feed level did not equal that of steers wintered on a higher level, as the greater pasture gains did not entirely offset the lower gains made on the low level winter ration.

Experiments by Bohman (1955) using early and late cut native hay showed that over a two year period the level of wintering had no effect on total weight gains. Weanling calves fed early cut hay gained significantly more during the first winter; calves wintered on poor quality late cut hay gained significantly more on grass the following summer, but those wintered on early cut hay still weighed significantly more. As yearlings greater gains were again made on the early cut hay and again those on the late cut hay made greater gains on pasture, enough greater in fact to completely erase the difference of the two wintering periods combined.

Dyer (1952) found that to reach "choice" grade, yearling cattle wintered on a high level required less corn than calves wintered on dry blue grass when both were grazed on similar pasture during the summer.

Stephens, et al. (1949) found that winter gains appeared to have little influence on gains made in the feed lot, after a period of early summer grazing. The steers wintered at the higher level were slightly fatter, however. From an economic standpoint, over all gain, and finish it was pointed out that the producer who expects to graze yearling steers during the early summer would find it more satisfactory to have them gain from one-half to three-fourths of a pound per head daily during the winter. If they were to be sold at the end of the wintering phase, gains of one to one and one-half pounds per head daily were most desirable.

According to Nelson and Campbell (1954) the increased feed cost from adding corn to a winter ration of prairie hay and cottonseed pellets was greater than the increased value of the steers, when sold after grazing and full feeding.

Ross, et al. (1947) found that calves wintered on grass and cottonseed meal to gain from one-half to three-fourths of a pound daily produced desirable feeder yearlings at a greater profit than those gaining one to one and one-half pounds per head daily.

McC Campbell and Weber (1942) made a comparison between wintering heifers on good quality roughage plus one pound of protein and the same ration plus three or four pounds of grain, they were then grazed on bluestem, which was followed by full feeding. The net return was slightly in favor of the heifers

wintered without grain. The first lot consumed more roughage and less grain; the second was marketed earlier at the same degree of finish.

The findings of Nelson, et al. (1951) showed that steers making the greatest profit were rough wintered on dry grass with a protein supplement and no grain, and grazed on pasture without any other feed during the summer. It was not as profitable to feed grain on grass in the summer as to allow grazing only; it was not as profitable to feed three pounds of grain either in dry lot or on dry grass during the winter phase along with the protein supplement fed.

Black, et al. (1939) have recommended that steer calves to be developed into two year old feeder steers be in a thrifty condition and wintered to gain from 25 to 50 pounds per head. Yearlings should be kept in thrifty condition on a plane of nutrition slightly above maintenance during the winter.

Sheets (1924) stated that cattle to be marketed early should be wintered well; cattle to be grazed all summer or carried over should be wintered on a lower plane of nutrition and allowed to catch up on grass. Due to small differences at the end of the grazing season any conclusion as to the best winter ration must take into consideration the cost of the ration.

Black (1927) stated that it is desirable to have calves and yearlings make a winter gain of 50 to 75 pounds.

Morrison (1936) stated that in order to have animals ready at the time of a high market or due to high grain prices it may be economical to feed less grain and other concentrate than is normal.

Winchester (1951) using identical and fraternal twin beef steers and feeding all the way from just above maintenance to liberal rations for six months found that the energy required by animals on the restricted ration to reach a given weight compared favorably with that consumed by controls.

Winchester and Howe (1955) did not find the carcass grades, meat quality or quantity of lean meat in the carcass decreased by interruption of growth. The period of restricted energy intake did not influence the dressing percentage adversely.

Somewhat different results to the above were obtained by McCampbell, et al. (1940). The feeding of four and one-half pounds of grain in the wintering ration of steer calves showed a small advantage over no grain in appearance of the calves, selling price and margin over a three year average.

Black and Clark (1938) found that yearling steers wintered on the range with supplemental feed returned more profit than those wintered in dry lot on straw and protein.

Generally two-thirds of the yearly feed cost for calves was the winter feed bill according to Black (1927) and Sheets and Tuckwiller (1922). Therefore the profit made was largely determined by this winter feed cost and it was important to feed a

combination of feeds in the winter ration to produce satisfactory gains at the lowest cost. If the bulk of the gain in weight was made on grass the economy of gain was increased.

Black, et al. (1936) found that silage used with alfalfa hay had a decided advantage over other rations used when maximum gains were desirable and an early sale of the animals from the feed lot was anticipated. Calves so wintered carried more fleshing than was desired for maximum usage of grass, but the gains were economical.

Darlow, et al. (1948) found it was most profitable to winter steer calves on cured range grass, supplemented with cottonseed meal when they were to be sold as stocker steers off grass in the fall.

Work by Black and Mathews (1937) at Ardmore, South Dakota, showed it to be much more economical to winter steers on the range and to supplement it with concentrates and dry roughage during inclement weather or when snow covered the ground, than to winter them in dry lot.

According to Snapp (1952) heifer calves mature earlier than steers. He reported heifers were ready for market six to ten weeks before steers when started on feed at the same time. Heifers weighing 700 to 900 pounds showing good condition and finish at around 12 to 15 months of age had little likelihood of being pregnant and sometimes sold for nearly the same price as steers.

This may be an important factor in the proper level of wintering for heifers. If they are faster maturing they may fatten with less concentrate than steers.

It was of interest to note that Guilbert, et al. (1944) observed significantly heavier hind quarters in steer calves making continuous gains than in calves whose growth was retarded after weaning. It was pointed out that the hind quarter is a later maturing part.

It was stated by Morrison (1936) that due to strong growth impulse, calves gain well on a good quality roughage ration and therefore a very liberal concentrate ration must be supplied in order to produce fatty tissue rather than growth alone.

Hedrick, et al. (1954) used 33 Hereford feeder steers and three planes of winter nutrition to test the effect of plane of wintering on quality of beef. The steers gained one and one-half pounds, one pound, and lost four-tenths of a pound per head daily on the three winter rations. They were grazed on summer pasture and finished to grade "choice" in dry lot. There were highly significant differences between lots in percent of fat and lean in the 9-10-11th rib and percent ether extract in the rib eye. Carcasses from cattle on the low plane of wintering had more separable fat, less separable lean, and less fat in the rib eye, than carcasses from the other two lots of better wintered steers. A palatability committee found no significant difference in tenderness in cooked rib roasts and rib steaks. Shear tests

confirmed the findings of the panel. There was no significant difference in carcass measurements. Carcasses from the lower plane of wintering graded lower and showed greater variability in grade than the other lots.

The weight loss of two year old steers enroute to market varied from 4.8 to 6.3 percent with no definite trend in favor of high or low level of wintering according to Sheets (1924). Dressing percentage was highest for the lot that made the greatest winter and total gain and lowest for the lot that made the least gain. Although no definite conclusions can be drawn due to insufficient numbers, the facts indicate a trend.

In the work done by Guilbert, et al. (1944) weanling calves supplemented on dry grass so that good growth gains were made had slightly higher shipping shrinkage, slightly higher dressing percentage, and slightly higher grading carcasses than calves that lost weight on dry grass but made faster gains on grass and in the dry lot.

Morrison (1936) stated that steers making gains of one-half pound daily had a considerable amount of fatty tissue containing 73 percent fat and only 18 percent water. Fatty tissue had almost entirely disappeared from a steer that had been losing one-half pound daily, and what fatty tissue remained contained only five percent fat and 81 percent water. The skeleton is affected little from under nutrition except that eventually fat in the bone is replaced with water.

EXPERIMENTAL MATERIALS, METHODS AND PROCEDURE

The heifers used in all three experiments were good to choice quality Hereford heifers varying in average weight for any one year from 357 to 482 pounds. They were delivered to Manhattan between September 15 and December one, varying with the year, and maintained chiefly on silage, prairie hay and one pound of protein concentrate per head daily until they were started on experiment. They were fed some grain prior to the start of the experiment in some years.

They were individually weighed two consecutive days just before the start of a test. The average of the two weights was used in allotting them so that as nearly as possible all lots were about equal in weight. Ten to 11 head were used in each lot each year. In a few instances individuals were removed from test when absolutely necessary.

During the wintering phase cattle were fed once daily. During the full feeding phase cattle in dry lot were fed morning and evening. Cattle full fed grain on grass were fed once daily, in the morning. Water was heated enough to keep ice from forming in the tanks for those heifers wintered in dry lot. The ice had to be chopped and broken then removed from the tanks in the pastures used for wintering heifers on dry grass. Salt and water was provided free choice at all times in all phases. Ground limestone at the rate of one-tenth of a pound per head daily was fed during the

full feeding phase in all the years except when alfalfa hay provided part or all of the roughage ration. The longest wintering period was 170 days in duration, the winter of 1952-53 with lot six; the shortest was 111 days in the winter of 1953-54 also with lot six. The longest grazing period lasted 100 days the summer of 1947; the shortest was 58 days the summer of 1954 with lot five. The average length of the wintering period was 153 days, and the average length for grazing was 77 days. The longest full feeding phase was 117 days in length in 1952, the shortest 84 days in 1947, and the average 103 days.

The carcass data was acquired by college personnel with the cooperation of the packers buying the animals. The carcasses were graded by an official United States Department of Agriculture meat grader each year.

The following United States Department of Agriculture grades for beef cattle were used: prime, choice, good, commercial, utility, cutter, and canner. Each grade was divided into a third of a grade as top, average or low for that grade. A numerical value was assigned to each third of a grade, starting with one for low canner and working up to 21 for top prime. The higher the numerical grade, the higher the carcass grade. For yearly and average feed prices for each experiment consult Table 1.

Experiment I

The only difference between lot 1 and 2 in this experiment was that lot 1 received two pounds of grain per head daily during

the winter period whereas lot 2 received no grain. (Table 2). The experiment is an average of three tests conducted during the years 1946-47, 1948-49 and 1949-50. The average starting date for the tests was November 28. The winter feeding phase lasted an average of 154 days until May first, when the heifers were moved to pasture and grazed on bluestem grass an average of 82 days until July 22. The full feeding phase on bluestem grass lasted an average of 97 days, or until October 27, when they were marketed.

During both the wintering and full feeding phase the heifers were fed once a day, in the morning. The grain used both in wintering and full feeding rations was ground shelled corn. One-tenth of a pound of ground limestone per head daily was fed in the wintering ration to both lots during the year 1946-47. No source of calcium was fed in the wintering ration during the remaining years of the experiment. Ground limestone at the rate of one-tenth of a pound per head daily was fed during the full feeding phase each year.

Cottonseed meal was fed in the wintering phase of 1946-47 and 1948-49, and the full feeding phase of 1946-47. Soybean oil meal pellets (expeller process) was used in the wintering ration of 1949-50 and in the full feeding phase the years of 1948-49 and 1949-50.

Because she was found to be with calf a heifer was removed from the 1946-47 test on June 24, 1947. All lots were hand fed during the fattening phase.

Experiment II

The experimental treatment for lot 3 was the addition of two pounds of grain per head daily to the winter ration, whereas lot 4 received no grain during the winter. (Table 3). This was the only difference in treatment for the two lots except that in the first three tests the protein concentrate fed during the winter was different.

Experiment II is an average of four tests from 1947-48 through 1950-51. The average starting date for the tests was November 23. The winter feeding period lasted an average of 161 days, until May second, when the heifers were moved to pasture and grazed on bluestem grass an average of 76 days, or until July 17. The full feeding phase lasted an average of 103 days, ending on October 29 at the time the cattle were marketed.

The heifers were fed once daily during the wintering phase. While on full feed in dry lot they were fed twice daily, morning and evening, except during the final year of the experiment (1950-51) when they were self-fed grain during the fattening period. The first three years of the experiment ground shelled corn was the grain used in both the full feeding and wintering phases. The final year, 1950-51, milo grain was used for both phases. No supplemental source of calcium was provided in the wintering rations. Alfalfa served as a source of calcium in the full feeding ration for the years 1947-48, 1948-49 and 1950-51. Ground limestone was used in the fattening ration in 1949-50.

The source of protein supplement used in the wintering ration was not always the same, but the results of previous experimental work at this station indicated that this factor should have little or no effect on the gains made. The winter of 1947-48 lot 4 was fed a protein concentrate in the form of mustard seed meal, whereas lot 3 was fed cottonseed meal. The winter of 1948-49 lot 3 was fed linseed oil meal (36% crude protein) and lot 4 received an equal amount of cottonseed meal. Cottonseed oil meal (solvent process) was fed to lot 3, and lot 4 was fed soybean oil meal pellets (expeller process) during the winter phase of 1949-50. Both lots were fed soybean oil meal pellets in the wintering ration of 1950-51.

Foul foot was prevalent during the first two and one-half months of the 1947-48 grazing season. In the 1950-51 test one heifer was removed from each of the lots because of low gains made during the wintering phase. The sorghum silage, Tennessee Orange, used in the winter of 1950-51 was acid and contained very little grain; the heifers did not consume it readily. The prairie hay was cut late, about September first, but was still fair quality hay.

Experiment III

The difference in treatment between lots 5 and 6 was in the method of wintering. (Table 4). Lot 5 was wintered in dry lot on a medium to high plane of nutrition, whereas lot 6 was wintered

on a low level of nutrition on dry bluestem pasture. After the wintering period the two lots were treated identically.

An average of three tests conducted during the years 1951-52, 1952-53 and 1953-54 make up the experiment. The average starting date for the tests was December four. Due to the different dates the two lots were started on summer grass, the average length of the wintering and grazing phases are different. The heifers in lot 5 were wintered in dry lot an average of 152 days until May fifth. They were then taken to pasture and grazed an average of 67 days until July 12. Then they were moved to dry lot and self-fed grain 110 days until marketed on the 30th of October.

The heifers in lot 6 were wintered on dry grass an average of 138 days until April 21. In the winter of 1952-53, 0.3 of a pound of ground shelled corn was fed per head daily to lot 6. No grain was fed the other two winters. After the wintering period was terminated, they were continued on bluestem pasture an average of 81 days until July 12, at which time they were moved to dry lot and self-fed grain 110 days until sold.

The heifers were fed once a day during the wintering phase. The water for lot 5 was heated during the wintering phase; the ice had to be chopped and broken then removed from the tanks in the pastures used for wintering the lot 6 heifers on dry grass. Soybean oil meal was fed in the wintering and fattening rations in the 1952-53 test. In 1951-52 and 1953-54 tests cottonseed meal was used for both the wintering and finishing phases.

Ground milo grain was fed in the wintering ration to lot 5 in 1951-52 and 1953-54. Ground shelled corn was fed in the wintering ration of lot 5 in the 1952-53 test. For full feeding the heifers, the only grain used was ground shelled corn.

A mineral mixture consisting of two parts steamed bone meal and one part salt was fed in the wintering ration each year to both lots. Ground limestone at the rate of about one-tenth of a pound per head daily was fed during the fattening phase every year.

In the fall of 1951-52 all the heifers were fed two pounds of grain and one pound of protein concentrate per head daily in addition to roughage, for a short period prior to the start of the experiment. As a result the heifers were in good "flesh" at the start of the test, which was probably a disadvantage to lot 6.

The weather was favorable for wintering on dry grass during 1951-52, except during the month of December and a storm the first week in March. The heifers wintered on dry bluestem pasture were strong and healthy at the close of winter. They were wintered on a 190-acre bluestem pasture with ten steer calves. The pasture was stocked the previous summer at a normal rate, but plenty of dead grass remained. The silage fed to lot 5 during the winter was of poor quality. The first part of the winter it was Tennessee Orange, which was immature, excessively acid and with very little grain. The second part of the winter, mixed Atlas Sorgo and volunteer Black Amber were fed. This was dry with hardly any grain.

Table 1: Yearly and experimental averages of feed prices for Experiments I, II, and III for the years 1946-1954.

Year:	Ground: Corn	Milo: Grain	Protein: Conc.*	Alfalfa: Hay	Prairie: Hay	Sorghum: Silage	Salt	Ground: Limestone	Summer: Grass	Dry: Grass	Minerals:
	per bu	per cwt	per ton	per ton	per ton	per ton	per ton	per ton	per head	per head	per cwt
									monthly:		

Experiment I:											
1946-47	\$2.40		\$ 90.00		\$15.00	\$ 5.00	\$12.00	\$12.00	\$10.00		
1948-49	1.25		75.00		15.00	6.50	12.00	12.00	12.00		
1949-50	1.25		75.00		13.00	6.50	12.00	12.00	12.00		
Average	1.63		80.00		14.33	6.00	12.00	12.00	11.33		

Experiment II:											
1947-48	\$2.00	----	\$ 75.00	\$20.00	\$15.00	\$ 6.50	\$12.00	\$12.00	\$10.00		
1948-49	1.25	----	75.00**	20.00	15.00	6.50	12.00	12.00	12.00		
1949-50	1.25	----	75.00	17.00	13.00	6.50	12.00	12.00	12.00		
1950-51	----	\$2.30	75.00	20.00	13.00	6.50	12.00	12.00	16.00		
Average	1.50	2.30	75.00	19.25	14.00	6.50	12.00	12.00	12.50		

Experiment III:											
1951-52	\$1.90	\$2.80	\$100.00		\$15.00	\$ 6.50	\$12.00	\$12.00	\$25.00	\$.50	\$ 5.00
1952-53	1.60	----	95.00		25.00	10.00	12.00	12.00	16.00	.50	5.00
1953-54	1.60	----	75.00		20.00	8.00	12.00	12.00	16.00	.50	4.00
Average	1.70	2.80	90.00		20.00	8.17	12.00	12.00	19.00	.50	4.67

* Protein concentrate of whatever source was the same in price unless otherwise indicated.
** Lot 3 was fed linseed meal at \$80 per ton in the winter ration. Cottonseed and soybean meal fed to the other lots during both phases, and to lot 3 in the full feeding phase was \$75 per ton.

The winter of 1952-53 in general was mild and favorable for wintering on dry grass. There were three snow storms; one the latter part of November left snow covering the grass three weeks. The heifers wintered in dry lot showed considerable fleshing at the end of the wintering period. This probably affected the summer gain to some extent.

The winter of 1953-54 was mild and very favorable for wintering cattle on dry grass.

EXPERIMENTAL RESULTS AND DISCUSSION

Experiment I

The two pounds of grain fed to lot 1 as shown in Table 2 increased the winter gain .26 of a pound per head daily. This increase in winter gain was offset somewhat by a lower summer gain of .25 of a pound per head daily. This favorable margin in weight gain for lot 1 was narrowed still more during the full feeding phase by a gain of .15 of a pound more per head daily made by the heifers in lot 2. The total gain was only one pound greater for lot 1 than for lot 2. The percent shrink to market was greater for the heifers fed grain during the winter, which may have contributed to the fact that they dressed one percent higher.

The cost of feed per hundred weight of gain was greater for lot 1 due to the grain they were fed in the wintering ration.

The margin above feed and initial cost was in favor of lot 2, fed no grain in the winter, due to the lower cost per hundred pounds of gain.

Little difference was noted in selling price in this test. In 1946-47 the heifers in lot 1 sold for \$1.00 more per hundred than those in lot 2. In contrast to the \$.50 per hundred greater selling price for lot 2 in 1948-49. Both lots sold for the same price per hundred in 1949-50.

The average daily and total gains made by the two lots were the same in 1949-50. Greater fattening gains were made in the 1946-47 test by lot 1; the fattening phase was only 84 days in length. The other two years the finishing gain was in favor of lot 2.

There appeared to be little value, in this experiment, in the addition of two pounds of grain per head daily in the wintering ration of heifer calves on a wintering, grazing and fattening program.

Experiment II

As a result of feeding two pounds of grain per head daily lot 3 in Table 3 made .22 of a pound greater daily gain than lot 4 during the wintering phase. Some of this advantage was erased when lot 3 made .12 of a pound less daily gain on pasture. However, in two out of the four years the heifers in lot 3, made equal or greater grass gains than lot 4. The heifers in lot 4 made slightly greater daily gains of .08 of a pound on full feed,

Table 2: A comparison of two pounds of grain and no grain in the wintering ration of heifer calves that are to be early summer grazed on bluestem pasture. (1946-47, 1948-49, 1949-50)

Lot number	:	1	:	2
Number of heifers in test	:	32	:	31
Phase 1--Wintering, 154 days				
Av. initial wt. per heifer		426		424
Av. final wt. per heifer		615		576
Av. gain per heifer		189		152
Av. daily gain per heifer		1.24		0.98
Av. feed per head daily, lbs:				
Sorghum silage		21.63		22.23
Prairie hay		2.46		2.76
Grain		2.03		---
Protein concentrate		1.0		1.0
Phase 2--Grazing, 82 days				
Av. gain on grass		79		100
Av. daily gain on grass		99		1.24
Phase 3--Full Feeding, 97 days				
Av. initial weight		694		676
Av. final weight		864		861
Av. gain		169		185
Av. daily gain		1.76		1.91
Av. feed per head daily, lbs:				
Grain		11.7		11.7
Protein concentrate		1.63		1.62
Ground limestone		.10		.10
Bluestem grass		ad lib		ad lib
Summary (Phases 1, 2, and 3), 332 days				
Av. total gain per heifer		438		437
Av. daily gain per heifer		1.32		1.31
Av. cost of feed per 100 lbs. gain		\$18.30		\$16.64
Av. cost of heifers per cwt.		\$22.47		\$22.47
Av. selling price per cwt.		\$25.50		\$25.33
Av. margin above feed and initial cost		\$35.03		\$42.88
Av. percent shrink		4.16		3.56
Av. dressing percent		59.9		58.9
Av. carcass grade(numerical value)*		11.5		11.2

* A numerical value was assigned each third of the USDA Grades: Top prime, 21; Av. prime, 20; Low prime, 19; etc. down through choice, good, commercial, utility cutter and canner with low canner receiving a grade of one.

but did not completely erase the margin of difference. The total gain for all three phases was 17 pounds per heifer in favor of lot 3, fed two pounds of grain per head daily during the winter. Lot 3 made greater total gains every year except in 1949-50.

The average cost of feed per hundred pounds of gain was \$1.06 less for the heifers on the lower level of wintering. The average higher selling price for lot 3 of \$.38 per hundred weight, as a result of higher selling prices two of the four years, reflected a slight difference in outward appearance at the time they were marketed. The margin of profit was essentially the same for both lots; however, it was greater for lot 4 every year except the last one, 1950-51. The dressing percentage was .9 percent higher for lot 3 than 4.

In this experiment the addition of two pounds of grain per head daily to the wintering ration of heifer calves might be termed optional. From the standpoint of margin of profit the \$.24 greater profit made by lot 3 is of little importance.

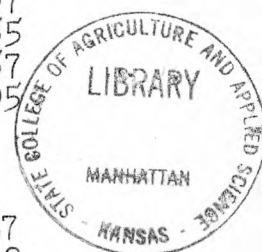
Experiment III

The winter gain made in this experiment reported in Table 4 was very markedly in favor of lot 5, wintered in dry lot. The cost of wintering, however, was greatly in favor of lot 6, wintered on dry grass. The heifers in lot 5 generally finished the winter in "fleshy" condition; those in lot 6 were thin, but strong and healthy. The thin but thrifty condition of the heifers in lot 6 made for good grass utilization and greater grass gains.

Table 3: A comparison of two pounds of grain and no grain in the wintering ration of heifer calves that are to be early summer grazed on bluestem pasture and then full fed grain in dry lot. (1947-48, 1948-49, 1949-50, 1950-51)

Lot number	:	3	:	4
Number of heifers in test	:	39	:	40
<hr/>				
Phase 1--Wintering, 161 days				
Av. initial weight per heifer		435		426
Av. final weight per heifer		636		592
Av. gain per heifer		201		166
Av. daily gain per heifer		1.25		1.03
Av. feed per head daily, lbs:				
Sorghum silage		19.91		19.74
Prairie hay		3.59		4.28
Grain		1.98		----
Protein concentrate		1.0		1.0
Phase 2--Grazing, 76 days				
Av. gain on grass		79.5		88
Av. daily gain on grass		1.06		1.18
Phase 3--Full Feeding, 103 days				
Av. initial weight		715		679
Av. final weight		917		890
Av. gain		202		211
Av. daily gain		1.96		2.04
Av. feed per head daily, lbs:				
Grain		13.15		13.07
Protein concentrate		1.55		1.55
Prairie hay		5.57		5.57
Alfalfa hay		3.07		3.05
Summary (Phases 1, 2, and 3), 340 days				
Av. total gain per heifer		482		465
Av. daily gain per heifer		1.42		1.37
Av. cost of feed per 100 lbs. gain		\$17.68		\$16.62
Av. cost of heifers per cwt.		\$25.75		\$25.75
Av. selling price per cwt.		\$29.38		\$29.00
Av. margin above feed and initial cost		\$62.68		\$62.44
Av. percent shrink		3.15		3.01
Av. dressing percent		59.3		58.4
Av. carcass grade(numerical value)*		13.6		13.3

* A numerical value was assigned each third of the USDA Grades: Top prime, 21; Av. prime, 20; Low prime, 19; etc. down through choice, good, commercial, utility cutter and canner with low canner receiving a grade of one.



Because of the average shorter wintering phase, lot 6 had a longer grazing period than lot 5. They made .95 of a pound per head daily greater gains on grass than those wintered in dry lot. This greatly narrowed the margin of difference in total weight gains and indicated that there was no harm to the heifers as a result of the low level of wintering.

Essentially the same daily weight gains were made in dry lot during the full feeding phase. Greater gains were made in two out of the three years by lot 6. The probable reason for the greater gains made by lot 5 the third year was due to difficulty encountered in getting lot 6 on full feed. Lot 5 graded slightly over a third of a grade higher than lot 6, corresponding to the higher level of wintering they received. They also had a dressing percent of 2.2 percent higher. The total gain per heifer was greater for lot 5 by 33 pounds.

The average feed cost was \$2.97 greater per hundred pounds gain for lot 5, but they also sold for an average of \$1.08 more per hundred weight than lot 6. The margin of loss was \$1.91 per hundred pounds more for the heifers wintered on the higher plane of nutrition than those wintered on dry grass. The larger loss was due primarily to higher winter feed costs for this lot. The first year of the experiment when the loss was the greatest, \$43.81 for lot 5 and \$37.72 for lot 6, both lots of heifers sold for the same price per hundred. Thereafter lot 5 sold for more per hundred than did lot 6. Only in 1953-54 did the heifers show a profit above feed and initial cost. Lot 5 had a \$34.02 margin

Table 4: A comparison of wintering heifer calves on dry grass and in dry lot that are to be early summer grazed on bluestem pasture and then full fed in dry lot. (1951-52, 1952-53, 1953-54)

Lot number	:	5	:	6
Number of heifers in test	:	30	:	30
Phase 1--Wintering				
Av. number of days in period		152		138
Av. initial weight per heifer		428		428
Av. final weight per heifer		628		513
Av. gain per heifer		200		85
Av. daily gain per heifer		1.31		0.6
Av. feed per head daily, lbs:				
Sorghum silage		21.41		----
Prairie hay		2.22		0.85
Grain		1.98		0.1
Protein concentrate		1.0		1.49
Dry bluestem pasture				free choice
Phase 2--Grazing				
Av. number of days on grass		67		81
Av. gain on grass		65		151
Av. daily gain on grass		0.96		1.91
Phase 3--Full Feeding, 110 days				
Av. initial weight		691		662
Av. final weight		944		910
Av. gain		253		249
Av. daily gain		2.3		2.27
Av. feed per head daily, lbs:				
Grain		14.41		14.06
Protein concentrate		1.67		1.69
Prairie hay		5.34		5.86
Summary (Phases 1, 2, and 3), 328 days				
Av. total gain per heifer		516		483
Av. daily gain per heifer		1.58		1.47
Av. cost of feed per 100 lbs. gain		\$22.77		\$19.80
Av. cost of heifers per cwt.		\$29.00		\$29.00
Av. selling price per cwt.		\$25.75		\$24.67
Av. loss after feed and initial				
cost		-\$6.08		-\$4.17
Av. percent shrink		2.81		2.61
Av. dressing percent		61.3		59.1
Av. carcass grade(Numerical value)*		16.7		15.4

* A numerical value was assigned each third of the USDA Grades: Top prime, 21; Av. prime, 20; Low prime, 19; etc. down through choice, good, commercial, utility cutter and canner with low canner receiving a grade of one.

above feed and initial cost and lot 6 showed a margin of \$34.17 over feed and original calf cost.

Most of the factors in this test were in favor of the high level of winter feeding. The major factor in favor of the low level of wintering on dry grass was the lower cost of production which brought about fully as great a return per heifer. This hinged largely on the monetary value to be assigned dry bluestem pasture. This test demonstrated that heifers may be wintered at a low level, but the cost must be correspondingly low to be successful.

SUMMARY

In the final analysis of Experiment I there was little advantage to be noted for the addition of two pounds of grain per head to the wintering ration of heifer calves. In fact those wintered without grain had a low enough cost of production that they returned \$7.05 per head more than those wintered with grain in their winter ration.

In Experiment II, grain added to the winter ration increased; the total gain 17 pounds per heifer, the selling price \$.38 per hundred weight, and the yield 0.9 percent. The carcass grade and return per heifer was about the same regardless of winter treatment.

In Experiment III nearly every factor was in favor of the heifers wintered on a high plane of nutrition, as compared to dry grass, except return per heifer, and this hinged on the charge to be made for dry bluestem pasture.

From observations made in these experiments grain is not necessary in the winter ration of heifer calves on a wintering, grazing and fattening program. Heifers may be successfully wintered on low quality roughage in this type of program if its cost is low enough.

ACKNOWLEDGMENTS

The author wishes to acknowledge his indebtedness to Ed F. Smith, Associate Professor of the Department of Animal Husbandry, for his assistance and advice.

The writer also wishes to express his appreciation to Mrs. Anne L. Severns, his wife, for her encouragement and assistance in the writing of the thesis.

LITERATURE CITED

- Black, W. H.
Wintering beef cattle in the Appalachian region. U.S.D.A.
Cir. 408. 1927. 12 p.
- Black, W. H. and V. I. Clark
Effect of supplementing winter and summer range on gains of
beef steers in the Northern Great Plains. U.S.D.A. Tech.
Bul. 628. 1938. 16 p.
- Black, W. H. and O. R. Mathews
Comparison of feeds for wintering steers in the Northern
Great Plains. U.S.D.A. Tech. Bul. 565. 1937. 10 p.
- Black, W. H., J. R. Quesenberry, and A. L. Baker
Effect of different methods of wintering beef calves, in the
Northern Great Plains, on winter gains and feed costs, and
on subsequent summer gains. U.S.D.A. Tech. Bul. 529. 1936.
11 p.
- Black, W. H., J. R. Quesenberry, and A. L. Baker.
Wintering steers on different planes of nutrition from
weaning to two and one-half years of age. U.S.D.A. Tech.
Bul. 667. 1939. 20 p.
- Bohman, Verle R.
Compensatory growth of beef cattle: the effect of hay
maturity. J. Animal Sci. 14:249-55. 1955.
- Clawson, A. B.
Normal growth of range cattle. U.S.D.A. Bul. 1394. 1926.
12 p.
- Darlow, A. E., O. B. Ross, and D. F. Stephens.
Effect of level of wintering of steer calves upon subsequent
summer gains. Original not seen. Abstract in J. Animal
Sci. 7:536. 1948.
- Dyer, A. J.
Maximum use of roughage and pasture in producing choice
two year old steers. Original not seen. Abstract in J.
Animal Sci. 11:783. 1952.
- Dyer, A. J. and Paul Guyer
Producing fat yearling steers utilizing maximum amounts of
roughage and pasture. Original not seen. Abstract in
J. Animal Sci. 9:674. 1950.

- Franklin, M. C., G. L. McClymont, P. K. Briggs and B. L. Campbell,
Maintenance rations for Merino sheep. Australian Journal of
Agricultural Research. 6:324-42. 1955.
- Guilbert, H. R. and G. H. Hart
California beef production. Calif. Agri. Ext. Service
Cir. 131. 1946. 157 p.
- Guilbert, H. R., G. H. Hart, K. A. Wagnon and H. Goss
The importance of continuous growth in beef cattle. Calif.
Agri. Expt. Sta. Bul. 688. 1944. 35 p.
- Hedrick, Harold B., D. E. Brady and A. J. Dyer
Effect of plane of winter nutrition on quality of beef.
Original not seen. Abstract in J. Animal Sci. 13:969. 1954.
- Johnson, R. F., E. P. Rinehart and C. W. Hickman
A system of wintering, pasturing and finishing beef calves
for Idaho. Idaho Expt. Sta. Bul. 292. 1952. 12 p.
- Kincaid, C. M.
The effect of winter weight changes on gains made from
pastures by beef steers. The American Society of Animal
Production. 32:111-116. 1939.
- Kincaid, C. M., George W. Litton and R. E. Hunt
Some factors that influence the production of steers from
pasture. J. Animal Sci. 4:164-73. 1945.
- Lush, Jay L., J. M. Jones, W. H. Dameron and O. L. Carpenter,
Normal growth of range cattle. Texas Agri. Expt. Sta.
Bul. 409. 1930. 34 p.
- McC Campbell, C. W., B. M. Anderson, H. E. Reed and A. D. Weber
Utilizing bluestem grass in fattening yearling steers for
market. Kans. State College Agri. Expt. Sta. Cir. 40-B-1.
1940.
- McC Campbell, C. W. and A. D. Weber
Two methods of utilizing bluestem grass in fattening yearling
heifers for market. Original not seen. Abstract in J.
Animal Sci. 1:65. 1942.
- Morrison, F. B.
Feeds and Feeding. Ithaca, New York. The Morrison Publishing
Company. 1936. 20th edition. 1050 p.

Nelson, A. B. and W. D. Campbell

The effect of level of wintering steer calves on their subsequent grazing performance. 28th Annual Livestock Feeders' Day Report. Okla. Agri. Expt. Sta. 1954. Pub. 114 p.

Nelson, A. B., R. A. Long, O. B. Ross, A. E. Darlow and W. D. Campbell

The effect of level of wintering upon the production of two year old steers marketed off grass. Okla. Agri. Expt. Sta. Misc. Pub. 22. 1951. 96 p.

Ross, O. B., D. F. Stephens, W. D. Campbell, V. G. Heller and A. E. Darlow

Summer gains of yearling steers wintered at different levels. Okla. Agri. Expt. Sta. Misc. Pub. 11. 1947. p. 34-48

Sheets, E. W.

Effect of winter rations on subsequent pasture gains of steers. Reprinted from J. of Agri. Res. Vol XXVIII No. 12, Washington, D. C., June 21, 1924.

Sheets, E. W. and R. H. Tuckwiller

Effect of winter rations on pasture gains of calves. U.S.D.A. Bul. 1042. 1922. 15 p.

Sheets, E. W. and R. H. Tuckwiller

Effect of winter rations on gains of calves marketed as three year old steers. U.S.D.A. Bul. 1431. 1926. 11 p.

Sheets, E. W. and R. H. Tuckwiller

Effect of winter rations on pasture gains of two year old steers. U.S.D.A. Bul. 1251. 1924. 24 p.

Snapp, Roscoe R.

Beef Cattle. New York: John Wiley and Sons. Chapman and Hall: London 1952. 4th edition. 641 p.

Stephens, D. F., O. B. Ross, W. D. Campbell, R. W. MacVican and A. E. Darlow

Summer gains of yearling steers wintered at different levels. 23rd Feeders' Day Report. Okla. Agri. Expt. Sta. 1949. 71 p.

Winchester, C. F.

Influence of interrupted growth of steers on carcass quality and feed economy. J. Animal Sci. 10:1067. 1951.

Winchester, C. F. and Paul E. Howe

Relative effects of continuous and interrupted growth on beef steers. U.S.D.A. Tech. Bul. 1108. 1955. 34 p.

THE INFLUENCE OF THE LEVEL OF WINTER NUTRITION
ON THE PERFORMANCE OF HEIFER CALVES

by

VIRGIL D. SEVERNS

B. S., Kansas State College
Of Agriculture and Applied Science, 1951

AN ABSTRACT OF
A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1956

The method of handling young heifers is of primary concern to a great many of the beef cattle producers and feeders of this area. Due to their lower cost per pound and their ability to finish faster, heifers are preferred to steers by some stockmen, as feeders.

This study was designed to determine how well heifers should be wintered that are to be grazed 70 to 80 days and then full fed approximately 100 days following the wintering period. Three "levels" of wintering were used. The "high" level consisted of a ration per head daily of two pounds of grain, a pound of protein concentrate and a full feed of good quality roughage. The "medium" level consisted of a pound of protein concentrate and a full feed of good quality roughage. The "low" level consisted of wintering the heifers on dry, unharvested bluestem grass supplemented with a pound and a half of protein supplement. In addition prairie hay was fed when the grass was covered by snow. Water, salt and minerals were always supplied free choice for all experiments.

In the final analysis of Experiment I there was little advantage to be noted for the addition of two pounds of grain per head daily to the wintering ration of heifer calves. In fact those wintered without grain had a low enough cost of production that they returned \$7.85 per head more than those wintered with grain in their winter ration.

In Experiment II, grain added to the winter ration increased: the total gain 17 pounds per heifer, the selling price \$.38 per

hundred weight, and the yield 0.9 per cent. The carcass grade and return per heifer was about the same regardless of winter treatment.

From the comparisons made between the medium and high levels of wintering the results indicate that over an average of several years there was no advantage of adding grain to the wintering ration.

In Experiment III, the heifers wintered on the high plane of nutrition were superior in performance in nearly every respect to those wintered on dry grass, except they failed to make any greater monetary return. The difference in monetary return hinged largely on the charge made for dry bluestem pasture.

Heifers wintered on the medium and low levels made greater grass and slightly greater fattening gains and consumed less total grain. They utilized a higher percentage of roughage in making gains. These experiments clearly show that heifer calves give a good account of themselves as consumers of roughage, grass and grain. They offer a definite possibility for producers with winter feed, but with only a small amount of good early pasture.

